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Olierafinaderij en petrochemische industrie. Ontstaan, samenstelling, voorkomen van petrochemische complexen

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SUMMARY.

This descriptive and explanatory study is an attempt to establish, with reference to the "industrial complex" concept, known in geography and economics, to what extent oil refineries affect the choice of location of certain primary petrochemical units, what petrochemical complexes may develop as a result, and where such complexes are situated in the European Community (of the Six).

The theoretical background to this study was taken from that part of location theory dealing with industrial enterprises. One of the assumptions made was that several phases, having differing spatial extents, can be distinguished in the choice of an industrial location. Possible phases for a petrochemical unit could be:

1. choice of the type of location (seaport, metropolis, complex);
2. choice between the alternatives available within the type selected (seaports);
3. choice within the seaport selected (Rotterdam).

Each of these phases has its own important and less important locational factors. This study is confined to those factors which are relevant to the choice of the type of location, that is to say to the orientation of location.

In order to prevent these factors, the basic or governing factors, from assuming too isolated a position, Chapter II gave a brief general introduction into the location problem. Reference was made to work done in this field by economic geographers and regional economists. This introduction was followed by an analysis, with reference to a literature survey, of the question as to what locational factors may be regarded as basic for the petrochemical industry, taking into account what was stated with regard to the phases to be distinguished. The following factors were found:

- a. range of base materials present
- b. transport costs
- c. economies of scale.

A detailed discussion followed of each of these factors and its more specific significance for the choice of location of petrochemical production units.

Before proceeding to develop the study further, three chapters were included to provide additional information on some aspects of this branch of industry, unfamiliar as it is to most students of the social sciences. Chapter III, therefore, explained the term "petrochemical industry" and contained a brief description of the terminology of chemical compounds. The final part of this chapter painted the growth of the petrochemical industry, and established a link with developments in the carbochemical industry, and its limited expansion possibilities.

Chapter IV gave an account of the choice of chemical compounds and primary petrochemical units discussed in this study. Only those compounds were included which may evidently be characterized as "growth products", generally on the ground of their

function as base material for the production of synthetic fibres, plastics and synthetic rubbers. This was illustrated by stating in terms of sales figures what derivatives were produced from ethylene, propylene, butadiene, benzene, toluene and xylene (para and ortho), the principal applications of these derivatives also being mentioned. To this chapter were appended a number of diagrams showing which derivatives could be obtained starting from these six base materials.

Chapter V dealt with the raw material relationship between the oil refinery on the one hand and the primary petrochemical units on the other. This chapter commenced with a brief discussion of the refining process, singling out the significance of the crude oil analysis and the demand for the various oil fractions, which in the European Community differs greatly from demand in the USA. Considering the growth of the petrochemical industry, special attention has been paid to the cracking and reforming processes in refining, and to the gaseous compounds in these processes. One of the main conclusions arising from this discussion was that the processing of oil refinery 'by-products', at least in the European Community, has lost almost all its importance for the petrochemical industry. Base chemicals should therefore be produced by processing specific oil fractions in separate production units (naphtha crackers, aromatics plants), a measure which would of course also imply consequences for the choice of location of such plants.

After some technical aspects of the production of olefins and aromatics from oil fractions were touched upon, "petrochemical refining" was dealt with, a process in which the refining of crude oil and the manufacture of petrochemicals are combined technically and very often spatially as well. It was this chapter which supplied the basic data determining the choice of location for petrochemical production plants which was to be discussed in the subsequent chapters.

Although, considered merely within the framework of this study, the distribution pattern of oil refineries in the Community might be taken as a given fact, Chapter VI nevertheless gave a review of the changes in this pattern, with reference to the situation in 1960 and 1970. This was done because of the close spatial relationship assumed between the petrochemical industry and the oil industry. In dealing with the distribution pattern of oil refineries, emphasis has been laid in particular on the effect of "economies of scale" and developments in the field of oil transport (utilization of increasingly larger tankers and pipelines). The last part of this chapter concentrated on the consequences of the changes in the distribution pattern of oil refineries for the choice of location for primary petrochemical plants.

Chapter VII treated the aromatic plant, one of these primary plants. On the basis of five considerations it was discussed to what extent the likelihood existed of:

1. aromatics plants being located in the vicinity of oil refineries.

2. aromatics-processing units being located in the vicinity of aromatics plants.

Subsequently, with reference to the distribution pattern presented (with the aid of maps) for both the aromatics plants and for a number of aromatics-processing units (for cyclohexane, phthalic anhydride, dimethyl terephthalate, cumene and styrene respectively), the distribution to be expected on the basis of the preceding chapters was compared with the actual pattern of distribution, after which a number of conclusions were formulated with regard to the possible formation of complexes. The conclusion here was that "aromatics complexes" scarcely occur, if at all.

The same technique was employed in Chapter VIII for the naptha cracker. Reference was further made to the Western European ethylene pipeline network and to the different positions occupied by chemical companies and oil companies respectively. As for the aromatics derivatives in Chapter VII, a number of derivatives of olefines were mentioned in this chapter to provide a comparison between the predicted and actual pattern of distribution. These derivatives were polyethylene, ethylene oxide, polypropylene, acrylonitrile and vinyl chloride. The production of cumene and styrene was discussed once more, requiring as it does both an aromatic and an olefin. Unlike the situation in the case of aromatics, "olefin complexes" were found to exist.

Chapter IX, particularly with its survey of the petrochemical complexes in the European Community, was largely of the nature of a summary of the first, more general part of this study. It also, however, stated a five-category classification of the various complexes, on the basis of their genesis.

Chapter X commenced a more detailed analysis of one of these petrochemical complexes. For practical reasons, it was initially intended to take the complex in the Rotterdam port region, but it soon became evident that this complex was difficult to consider independent of the complexes in Antwerp and Terneuzen. For this reason it was decided to choose the "supercomplex" Rotterdam-Moerdijk-Flushing-Terneuzen-Antwerp. This analysis considered consecutively the base materials, the primary petrochemical units, other petrochemical production units, and the ancillary and secondary chemical plants. The production units specific to each of these four categories were identified, as well as the extent to which these units were integrated into the complex as a whole, by demonstrating the input and output of products and auxiliary products ("linkages"). On the basis of this a diagram was drawn showing the production units forming the complex, and their inter-relationships. This diagram clearly illustrated the interwovenness, referred to above, of the complexes in Antwerp, Terneuzen and Rotterdam (thus also justifying the term "supercomplex"), their integration being above all due to the pipeline system for the transport of crude oil, ethylene, oxygen and nitrogen.

To complete the study, the significance of the results (both of the general section and the analysis of the supercomplex) for physical planning was discussed, with especial reference of

course to the situation in the Netherlands and in the southwestern part of the Netherlands in particular. One of the conclusions drawn was that as regards this region's attractiveness for the location of petrochemical industry, too much importance has been attached to the presence of seaports while too little attention has been paid to the significance of the petrochemical complex.